



1999–2000 CATS ASSESSMENT

Open-Response Item Scoring Worksheet

Grade 11 – Science

The **academic expectations** addressed by the open-response item “Cell Comparison” are:

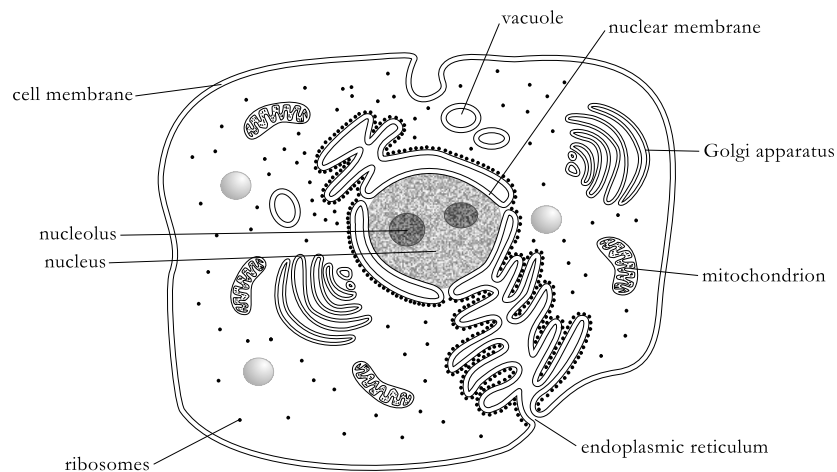
- 2.3 Systems – Students identify and analyze systems and the ways their components work together or affect each other.
- 2.4 Models and Scale – Students use the concept of scale and scientific models to explain the organization and functioning of living and non-living things and characteristics that might be observed.

The **core content** addressed by this item includes:

- SC-H-3.1.1 Cells have particular structures that underlie their function. Every cell is surrounded by a membrane that separates it from the outside world. Inside the cell is a concentrated mixture of thousands of different molecules that form a variety of specialized structures. These structures carry out specific cell functions.

Cell Comparison

Use the diagram below to answer the question.



The Cell and its Parts

The diagram above shows a cell with its organelles. Select four organelles from the diagram and explain how the structures and functions of those organelles within the cell are similar to the structures and functions of the different parts of your school.



SCORING GUIDE

Grade 11 Science

Score	Description
4	The response is complete and shows an in-depth understanding of the structure and function of cell organelles. The structures and functions of four organelles are accurately explained by relating their structure and function to a part of a school that is similar.
3	The response shows a general understanding of the structure and function of cell organelles. The structures and functions of three organelles are accurately explained by relating their structure and function to a part of a school that is similar. The explanation may lack detail and contain minor errors or misconceptions.
2	The response shows a limited understanding of the structure and function of cell organelles. The structures and functions of two organelles are reasonably explained, and/or there is an explanation of how to relate the organelles to a part of a school that is similar. The response may contain errors, misconceptions, or omissions.
1	The response shows a minimal understanding of the structure and function of cell organelles. The structure and function of at least one organelle is explained, or one organelle is related to a part of a school that is similar. The response contains major errors, misconceptions, or omissions.
0	Response is totally incorrect or irrelevant.
Blank	No response.

Science Behind the Question:

Example similarities:

Cell membrane—Contains the cell and controls the movement in and out of the cell; similar to a fence/building.

Nucleus—Contains the DNA that directs the activity of the cell; similar to the office/board of education/principal, or the teacher in the classroom.

Nucleolus—Produces ribosomes; similar to how counselors produce programs for students.

Nucleus and Nucleolus—Only parts that contain genetic material.

Vacuole—Storage structures for water, food, waste, chemicals; similar to storage closets/janitor.

Ribosomes—Produce proteins; similar to the way teachers package information in classrooms.

Endoplasmic Reticulum—A membrane of systems of folded sacs and tunnels; similar to the hallways.

Mitochondrion—Site of cellular respiration; similar to the cafeteria where sugar is broken down for energy.

Nuclear Membrane—A double membrane, with pores, surrounding the nucleus; similar to the office building with doors to go in and out of.

Golgi Apparatus—Packages proteins to be sent out of the cell; similar to the student store that packages items.



ANNOTATED STUDENT RESPONSE

Grade 11 Science

Sample 4-Point Response of Student Work

Student Response

The cell membrane which protects the cell and shelters it from other objects could be compared to the outer walls of our school building. Our school walls and structures continue to protect us from danger of all kinds, just as the cell membrane also protects the cell itself.

The nucleus of a cell is located directly in the center of that cell. It is where all of the important materials, such as DNA, are held. The main office in our school could be compared to the nucleus of a cell. This is because the main office is usually always located in the center of a school, and almost always contains all of your most important papers and information.

The nuclear membrane of a cell serves as the protective barrier for the nucleus. Just as our principals and faculty serve as the protective barrier for our important papers in our main office.

The ribosomes of a cell are the protein source and provider for the cell. I would use our school cafeteria which produces food for us to eat.

← Student accurately explains how the structure and function of one of the cell's organelles (the cell membrane) are similar to the structure and function of a part of a school (the outer walls).

← Student accurately explains how the structure and function of another organelle (the nucleus) are similar to the structure and function of a part of a school (the main office).

← Student accurately explains how the structure and function of a third organelle (the nuclear membrane) are similar to the structure and function of a part of a school (the principal and faculty).

← Student accurately explains how the structure and function of a fourth organelle (the ribosome) are similar to the structure and function of a part of a school (the cafeteria).

Overall, the student shows a strong understanding of the structures and functions of organelles within a cell and of how these organelle structures and functions can serve as a model for another type of system (i.e., a school). The student selects four organelles of a cell and accurately explains how the structures and functions of these organelles are similar to the structures and functions of the different parts of a school.



ANNOTATED STUDENT RESPONSE

Grade 11 Science

Sample 4-Point Response of Student Work

Student Response

The cell membrane of a cell serves to keep all things from entering and leaving a cell; it protects the inside parts of the cell from harm. Here at school, the cell membrane could be related to the walls. Not only do the walls support the school, but they keep us safe from harm and the elements.

The nucleus of the cell is like the brain. All instructions about what needs to be done originate from the nucleus; everything that is done comes from here. At school, the nucleus could be related to the office and principals. All instructions for the school originate from the office. The office controls everything.

The vacuoles of a cell serve as the waste collectors. They pick dead parts of the cell up as well as waste and get rid of it outside of the cell membrane. At school, a vacuole could be related to the custodian. They do a great job at collecting the waste around the school and getting rid of it.

The nuclear membrane of a cell serves to protect the nucleus from harm and interference. At school, the nuclear membrane could probably be related to the secretaries. They keep everyone out of the office that doesn't need to be and protect the principals from overload. They also observe what goes in and what comes out.

← Student accurately explains how the structure and function of one of the cell's organelles (the cell membrane) are similar to the structure and function of a part of a school (the walls).

← Student accurately explains how the structure and function of another organelle (the nucleus) are similar to the structure and function of a part of a school (the office and principals).

← Student accurately explains how the structure and function of a third organelle (the vacuole) are similar to the structure and function of a part of a school (the custodian).

← Student accurately explains how the structure and function of a fourth organelle (the nuclear membrane) are similar to the structure and function of a part of a school (the secretaries).

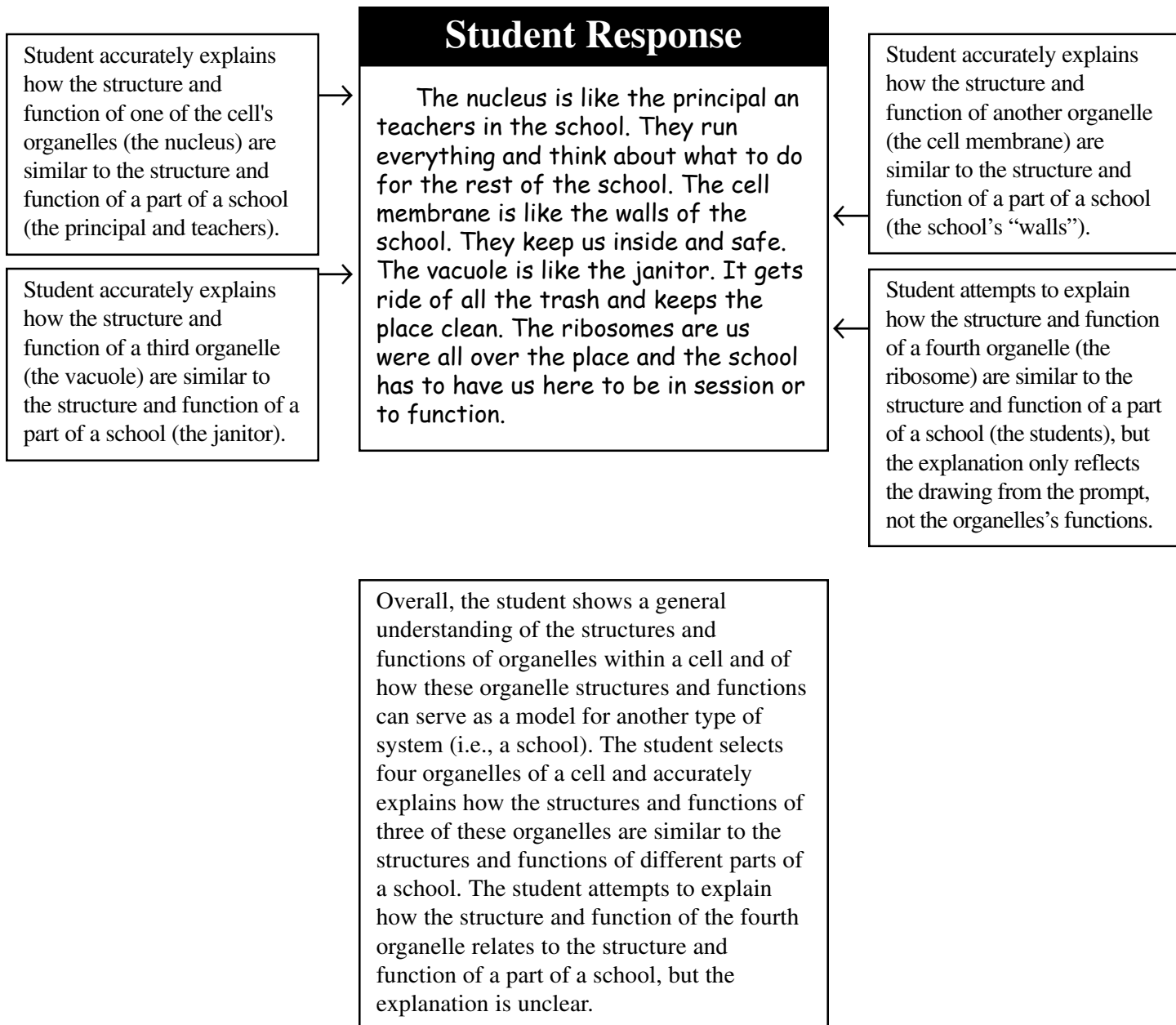
Overall, the student shows a strong understanding of the structures and functions of organelles within a cell and of how these organelle structures and functions can serve as a model for another type of system (i.e., a school). The student selects four organelles of a cell and accurately explains how the structures and functions of these organelles are similar to the structures and functions of the different parts of a school.



ANNOTATED STUDENT RESPONSE

Grade 11 Science

Sample 3-Point Response of Student Work





ANNOTATED STUDENT RESPONSE

Grade 11 Science

Sample 2-Point Response of Student Work

Student Response

Cells have many different parts, so does a school. In some ways they are alike. Our principal is in charge of our school he keeps us on track. He is like the control center. The control center of a cell is the nucleus. The nucleus tells the different parts of the cell what to do.

The cell membrane is the protection, the boundry of the cell. This could represent our walls, or even our security.

Little ribosomes are spread throughout the cell. Ribosomes could represent us students. We are all thought at the school and are the little guys.

← Student accurately explains how the structure and function of one of the cell's organelles (the nucleus) are similar to the structure and function of a part of a school (the principal).

← Student accurately explains how the structure and function of another organelle (the cell membrane) are similar to the structure and function of a part of a school (the school walls or security).

← Student attempts to explain how the structure and function of a third organelle (the ribosome) are similar to the structure and function of a part of a school (the students), but the explanation is unclear.

Overall, the student shows some understanding of the structures and functions of organelles within a cell and of how these organelle structures and functions can serve as a model for another type of system (i.e., a school). The student selects three organelles of a cell and accurately explains how the structures and functions of two of these organelles are similar to the structures and functions of different parts of a school. The student attempts to explain how the structure and function of the third organelle relates to the structure and function of a part of a school, but the explanation is unclear.



ANNOTATED STUDENT RESPONSE

Grade 11 Science

Sample 1-Point Response of Student Work

Student Response

Student attempts to explain how the structures and functions of three organelles of the cell (the Golgi apparatus, the endoplasmic reticulum, and the mitochondrion) are similar to the structure and functions of three parts of a school (the block walls, the back door, and a window), but the explanations are incorrect.

The golgi apparatus, is just the block walls of our school. They sound just alike, and both hold are need. Golgi apparatus help the cell. The block walls help the school.

The endoplasmic reticulum is like the back door of our school.

The cell membrane is like the outside walls of our school, it protects everything.

The mitochondrion is like a window because they let sunlight in.

Student reasonably explains how the structure and function of a third organelle of the cell (the cell membrane) are similar to the structure and function of a part of a school (the outside walls).

Overall, the student shows a minimal understanding of the structures and functions of organelles within a cell and of how these organelle structures and functions can serve as a model for another type of system (i.e., a school). The student selects four organelles of a cell and reasonably explains how the structure and function of one of these organelles are similar to the structure and function of a specific part of a school. The student attempts to explain how the structure and function of the other three organelles relates to the structure and function of a part of a school, but the explanations are incorrect.



INSTRUCTIONAL STRATEGIES

Grade 11 Science

The open-response item **“Cell Comparison”** was designed to address students’ (1) understanding of the particular functions underlying cell structures, and (2) ability to use evidence, logic, and scientific knowledge to develop and revise scientific explanations and models. The instructional strategies below present ideas for helping students explore and master these concepts and skills.

Discuss cell structure and function.

Create opportunities for students to work individually, in pairs, in small groups, and/or as a class to complete (with teacher guidance and support) any or all of the following activities:

- Create cell models, using nontoxic, biodegradable materials, to illustrate the appearance and position of various organelles within cells. Produce keys that include descriptions of organelle functions.
- Examine cell structures with a light microscope. Produce photo essays with student-created drawings of basic cell structure (e.g., cell wall, cell membrane, nucleus, cytoplasm, chloroplast, vacuoles). Describe functions of cell structures on the mechanical rather than biochemical level (e.g., nucleus and control of cell function, chloroplast and photosynthesis, mitochondria and respiration, cell membrane and transport). Include ways to test the assertion that chicken eggs are cells by comparing functions of different structures in eggs and in cells.
- Compare functions of cell organelles to city structures that have similar functions. Create multimedia presentations showing comparisons.
- Investigate life cycles of cells. Examine videos, slides, or photographs of various stages of mitosis and interphase. Recreate stages using students to represent chromosomes.
- Examine slides of various cell types from multicellular organisms. Discuss relationships between the structure of different cell types and their functions. Determine structure and functions all cells have in common.
- Trace paths of molecules (e.g., glucose, water) as they arrive at cell membranes and move through cells. Create bulletin boards demonstrating this movement.
- Research common diseases (e.g., cancer, influenza, diabetes, cystic fibrosis). Trace disease processes to changes in organ systems or cells. Develop informational brochures that describe diseases and changes they cause at the cellular and organ levels. Distribute brochures through county health departments.
- Investigate how and when cells differentiate. Read “How Does a Single Cell Become a Whole Body” by Caldwell in *Discover*, 1992. Trace the formation of germ layers and identify organ systems that develop from each layer. Create informational bulletin boards, collages, or posters. Examine drugs (e.g., thalidomide, alcohol) and diseases (e.g., rubella) that interfere with differentiation and organogenesis. Write articles to encourage pregnant women to refrain from drinking alcohol.



INSTRUCTIONAL STRATEGIES

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- Investigate embryonic development. Examine pictures of different species of embryos at different stages of development. Use graphic organizers to compare features. Research variables that affect embryonic development (e.g., thalidomide, alcohol, diseases). Develop informational brochures for expectant mothers explaining health hazards and distribute these through local health care facilities.
- Investigate the evolution of eukaryotic cells. Trace the origin of cell organelles. Use graphic organizers to compare characteristics of the oldest known cells to modern cells. Create illustrated time lines documenting milestones in the development of the cell theory.
- Investigate the loss of control over cell division exhibited by cancer cells. Identify chemical substances used in chemotherapy and their purposes. Interview community members who have had chemotherapy; examine the process and how it affected their lives. Write articles for science sections of newspapers and explain the idea that cancer is a normal developmental process gone wrong or write editorials to explain why money should be spent on basic research regarding the normal cell cycle.
- Observe microorganisms (e.g., bacteria, dinoflagellates, protozoans). Investigate beneficial and detrimental roles microorganisms play in environment (e.g., fermentation, food spoilage, diseases, decay, bioluminescence, food digestive processes, production of vitamins and antibiotics, nitrogen fixation). Create illustrated children's books describing microorganisms and their roles.